



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>C04B 28/02, 41/65, F16L 58/06 // (C04B 28/02, 14:10), 111:56</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 98/33749</b> <b>(43) International Publication Date:</b> 6 August 1998 (06.08.98)
<b>(21) International Application Number:</b> PCT/GB98/00305 <b>(22) International Filing Date:</b> 2 February 1998 (02.02.98) <b>(30) Priority Data:</b> 9702119.0 1 February 1997 (01.02.97) GB <b>(71) Applicants (for all designated States except US):</b> WRc PLC [GB/GB]; Henley Road, Medmenham, Marlow, Buckinghamshire SL7 2HD (GB). THE IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE [GB/GB]; Sherfield Building, London SW7 2AZ (GB). <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> CONROY, Paul, James [GB/GB]; WRc plc, Frankland Road, Blagrove, Swindon, Wiltshire SN5 8YF (GB). NEWMAN, John, Brian [GB/GB]; The Imperial College of Science, Technology and Medicine, Sherfield Building, London SW7 2AZ (GB). HUDSON, Lisa, Anne [GB/GB]; The Imperial College of Science, Technology and Medicine, Sherfield Building, London SW7 2AZ (GB). <b>(74) Agents:</b> CURTIS, Philip, Anthony et al.; A.A. Thornton & Co., Northumberland House, 303-306 High Holborn, London WC1V 7LE (GB).		<b>(81) Designated States:</b> DE, GB, JP, NO, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i>
<b>(54) Title:</b> CEMENTITIOUS COMPOSITIONS AND THEIR USE IN CORROSION PROTECTION  <b>(57) Abstract</b> <p>A cementitious composition (1) which, in the hardened state, acts as a low leaching coating in low alkalinity and low hardness waters. The composition comprises at least one cement and a highly reactive pozzolan. The cementitious composition can be applied to a surface such as a metallic drinking water pipe (2) in order to provide corrosion protection therefor.</p> <div style="text-align: center;"> </div>		

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**CEMENTITIOUS COMPOSITIONS AND THEIR USE**  
**IN CORROSION PROTECTION**

5       The present invention relates to cementitious compositions, and relates to the use of such compositions in corrosion protection.

      The corrosion of metals in contact with water occurs by an aqueous electrochemical mechanism. This involves the presence of water containing dissolved ions at the metal surface, and the corresponding transfer of the electrons from the metal surface to the aqueous environment in contact with it. Corrosion  
10      protection involves interfering with these processes.

      Current internal protection systems for water pipes usually consist of either cement mortars or epoxy resin polymeric coatings. Cement mortars suffer from a number of problems, such as lime leaching when placed in low alkalinity and low hardness waters. This results in impaired water quality by increasing the pH (ie  
15      the alkalinity) and calcium concentrations, and causes structural deterioration of the cement mortar, which results in poor durability. Epoxy resins can also suffer from a number of problems: if they are insufficiently cured, then there may be problems with water quality; there may be blistering; and there may be poor coverage at pipe joints.

20       We have now found a way to improve corrosion protection of metal surfaces, such as metallic drinking water pipes. We achieve this by providing a cementitious composition which, in the hardened state, acts as a low leaching and durable coating in low alkalinity and low hardness waters.

25       According to one aspect of the invention there is provided a method of protecting a surface from corrosion, comprising applying to the surface a cementitious composition which, in the hardened state, acts as a low leaching coating in low alkalinity and low hardness waters.

      The method can be used to protect a wide variety of surfaces from corrosion. The method is of particular use in preventing the corrosion of metal pipes  
30      from corrosion caused by moisture. The method has particular application to the protection of the inside of drinking water pipes.

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After the cementitious composition has been applied to the surface it can be left to harden. In general sufficient hardening will occur within about 24 hours, but it may take several weeks for the composition to finish curing.

The thickness of the composition depends upon the application.

5 Typically the composition would be applied to a thickness in the range 2 to 16 mm, and usually the thickness would be in the range 4 to 8 mm.

The cementitious composition advantageously comprises at least one cement and a component which is capable of reacting with free lime. This reduces the amount of lime available to leach. Advantageously, the cementitious  
10 composition comprises at least one hydraulic cement and a highly reactive pozzolan - the pozzolan is capable of reacting with the free lime.

It is preferred that the composition comprises not more than 50 parts by weight pozzolan, based on the weight of the dry composition, and not less than 5 parts by weight pozzolan based on weight of the dry composition. It is more  
15 preferred that the composition comprises not more than 30 parts by weight pozzolan, based on the weight of the dry composition.

In one embodiment, the cementitious composition may further comprise a cement replacement material, preferably in an amount of not more than 70 parts by weight, based on the dry composition. The cement replacement material  
20 assists in producing a dense cement with a fine pore structure in the hardened cement paste. The cement replacement material is preferably ground granulated blast furnace slag (GGBFS - available from Civil and Marine Slag Cement Limited), activated blast furnace slag, pulverised fuel ash (PFA - available from Pozzolanic Lytag) and/or microsilica powder (e.g. grade 940U available from Elkem Materials).

25 In certain embodiments, the composition may comprise not more than 10 parts by weight pozzolan, based on the dry composition. For example, when the cement replacement material is provided, it is preferred that the composition comprises not more than 10 parts by weight pozzolan, based on the dry composition.

30 A wide variety of cements may be used. Ordinary Portland cement (OPC) has been found to be very suitable. Examples of three commercially

available cements that are suitable for use with the present invention are: ordinary Portland cement to B.S. 12:1991 class 42.5N; Ferrocrete which is a rapid-hardening Portland cement to B.S. 12:1991 class 52.5N; and Sulfacrete which is a sulphate resisting Portland cement to B.S. 4027:1991 class 42.5N. All three of these cements are available from Blue Circle Industries.

The cement may be a Microcem cement, i.e., a superfine Portland cement having a greater surface area than conventional Portland cements. Microcem 550, Microcem 650SR or Microcem 900 may, for example, be used in the invention.

In an embodiment, the cement is a hydraulic cement. The hydraulic cement is preferably calcium silicate cement.

Pozzolans are silaceous and aluminous materials, such as certain fly ashes and blast furnace slags, which, in finely divided form, will exhibit cementitious properties when mixed with, for example, lime and water. We prefer to use a highly reactive pozzolan. We have obtained exceptionally good results when the pozzolan is metakaolin. Metakaolins can be formed from Kaolinite ( $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$ ) by heating, for example to about 500°C to about 800°C. Metakaolin is available from, for example, English China Clay International. Grade Metastar 501, available from English China Clay International, has been found to be very suitable.

The cementitious composition used in the method according to the invention may comprise other materials, such as aggregate and a reinforcement material such as a fibre reinforcement. The aggregate would typically be a fine grade silver sand having a moisture content of, for example, 4.7%. The reinforcement may be a polymeric fibre and may be present in an amount up to 40 parts by weight, based on the total weight of the dry composition.

The cementitious material may include other materials, such as silica fume.

In general, the cementitious composition according to the invention is mixed with water before use. This results in the formation of a cement paste. We prefer that the composition comprises not more than 50 parts by weight water, based on the wet composition.

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The composition may be mixed with sand in order to form a cementitious mortar. This cementitious mortar may then be applied to the surface to be protected. In general, the amount of sand will be about the same as the amount of cement.

5 In accordance with the invention a particularly preferred cementitious composition comprises:

Metakaolin:	5 to 15 wt%
OPC:	10 to 30 wt%
10 GGBFS:	60 to 80 wt%

The most preferred cementitious composition comprises:

Metakaolin:	10 wt%
15 OPC:	20 wt%
GGBFS:	70 wt%

20 A particularly effective cement mortar composition would comprise 1 part by weight of the cement composition with 1 part by weight sand and 0.35-0.55, preferably 0.40 to 0.45 parts by weight water.

According to another aspect of the invention there is provided a cementitious composition which, in the hardened state, acts as a low leaching coating in low alkalinity and low hardness waters.

25 Advantageously, the cementitious composition comprises at least one cement and a component that is capable of reacting with free lime, which component is preferably a highly reactive pozzolan.

Preferably, the composition comprises not more than 30 parts by weight pozzolan, based on the dry composition, and the composition comprises not less than 5 parts by weight pozzolan, based on the dry composition.

30 The cementitious composition according to this aspect of the invention may be provided with any combination of the features of the cementitious

composition described in relation to the method of protecting a surface from corrosion protection. The cementitious composition may be mixed with sand to form a cementitious mortar composition.

5 The method and composition according to the present invention make it possible to protect pipes, especially drinking water pipes, from corrosion, without the usual problems associated with cement mortars or epoxy resins.

Reference is now made to the accompanying drawings, in which:

Fig. 1 is a cross-sectional view of a flat surface that has been treated with a cementitious composition according to the invention; and

10 Fig. 2 is a cross-sectional view of a pipe that has been treated with a cementitious composition according to the invention.

In Fig. 1 a substantially planar metallic substrate 10 has been coated with a layer 12 of a cementitious composition comprising a hydraulic cement, a pozzolan and water. The cementitious composition was applied in the form of a  
15 paste to form the layer 12 and was then left to set. The cementitious material cured while in contact with the metallic substrate 10 and provides an alkaline environment in contact with the surface of the substrate 10. Once fully cured, the cementitious coating protects the substrate 10 from electrochemical corrosion and also from leaching of the cement by drinking water.

20 In Fig. 2 a substantially cylindrical metallic pipe 14 has been coated with a layer 16 of a cementitious composition comprising a hydraulic cement, a pozzolan and water. As in Fig. 1, the cementitious composition was applied in the form of a paste to form the layer 16 and was then left to set. The cementitious material cured while in contact with the internal surface of the pipe 14 and provides  
25 an alkaline environment in contact with the internal surface of the pipe 14. Once fully cured, the cementitious coating product protects the pipe 14 from electrochemical corrosion and also from leaching of the cement by drinking water.

The following examples illustrate the invention.

30 Example 1

Four cement compositions were prepared. One composition comprises

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100 wt% OPC. The other three compositions comprised: 90 wt% OPC, 10 wt% metakaolin; 80 wt% OPC, 20 wt% metakaolin; and 70 wt% OPC, 30 wt% metakaolin.

5 Each composition was mixed with water and sand at the sand:cement:water ratio 1:1:0.45.

Blocks of the cement were exposed to a low alkalinity water and the pH was monitored with time. There was a 24 hour retention time. The water hardness was 20mg/l as  $\text{CaCO}_3$ . The results are shown in Fig. 3, from which it is clear that the compositions containing metakaolin performed much better than the other compositions.

10

### Example 2

A cement composition was made comprising:

- 15
- (1) 20 wt% OPC to B.S. 12:1991 class 42.5N available from Blue Circle Industries.
  - (2) 70 wt% GGBFS from Civil and Marine Slag Limited
  - (3) 10 wt% metakaolin, grade Metastar 501 from English China Clay International (which is a particularly highly purified form of metakaolin).

20

Two ductile iron pipes of 100 mm diameter and 3 m total length were cut into 12 x 250 mm length sections. Each pipe was then in situ lined using standard small bore pipe rehabilitation equipment with the assistance of a local contractor. One pipe was lined with OPC blended with sand and water in the ratio 1:1:0.4. The second pipe was lined with the ternary composition according to the invention blended with sand and water in the ratio 1:1:0.43. The difference in water quantity was to produce optimum pump and surface finish properties.

25

After lining, the pipe sections were placed in airtight bags (to eliminate air circulation) with an environment humidity of about 62%, and were allowed to cure overnight at about 10°C for about 24 hours.

30

The effectiveness of the ternary blend was compared with the OPC



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over three different water hardnesses, and the results are shown in Figs 4 to 6. In each case the retention time was 8 hours. In Fig. 4 there was 10 mg/l as  $\text{CaCO}_3$ , in Fig. 5 there was 35 mg/l as  $\text{CaCO}_3$  and in Fig. 6 there was 55 mg/l as  $\text{CaCO}_3$ . In each case the composition according to the invention resulted in significant reductions in lime leaching.

5

It will be appreciated that the invention may be modified within the scope of the appended claims.

Claims

1. A method of protecting a surface from corrosion, comprising applying to the surface a cementitious composition which, in the hardened state, acts as a low leaching coating in low alkalinity and low hardness waters.  
5
2. A method according to claim 1, wherein the cementitious composition comprises at least one cement and a component which is capable of reacting with free lime.  
10
3. A method according to claim 1 or 2, wherein the cementitious composition comprises at least one cement and a highly reactive pozzolan.
4. A method according to claim 3, wherein the pozzolan is metakaolin.  
15
5. A method according to claim 3 or 4, wherein the composition comprises not more than 30 parts by weight pozzolan, based on the dry composition.
6. A method according to claim 3, 4 or 5, wherein the composition comprises not less than 5 parts by weight pozzolan, based on the dry composition.  
20
7. A method according to claim 3, 4, 5 or 6, wherein the composition comprises not more than 10 parts by weight pozzolan, based on the dry composition.
- 25 8. A method according to any one of claims 2 to 7, wherein the cementitious composition further comprises a cement replacement material in an amount of not more than 70 parts by weight, based on the dry composition.
- 30 9. A method according to claim 8, wherein the cement replacement composition is ground granulated blast furnace slag and/or pulverised fuel ash.

10. A method according to any one of claims 2 to 9, wherein the cement is a hydraulic cement.

5 11. A method according to claim 10, wherein the hydraulic cement is calcium silicate cement.

12. A method according to any preceding claim, wherein the cementitious composition further comprises aggregate.

10 13. A method according to any preceding claim, wherein the cementitious composition further comprises fibre reinforcement.

14. A method according to any preceding claim, wherein the cementitious composition further comprises water.

15 15. A method according to claim 14, wherein the cementitious composition comprises not more than 50 parts by weight water, based on the wet composition.

20 16. A method according to any preceding claim wherein the cementitious composition is mixed with sand to form a cementitious mortar composition, prior to being applied to said surface.

25 17. A method according to any preceding claim, wherein said surface is a metal surface.

18. A method according to any preceding claim, wherein said surface forms part of a pipe.

30 19. A method according to any preceding claim, wherein said cementitious composition is hardened after application to the surface.

20. A cementitious composition comprising at least one cement in combination with metakaolin.
- 5 21. A composition according to claim 20, comprising not more than 30 parts by weight metakaolin, based on the weight of the dry composition.
22. A composition according to claim 20 or 21, comprising not more than 10 parts by weight pozzolan, based on the dry composition.
- 10 23. A composition according to claim 20, 21 or 22, further comprising a cement replacement material in an amount of not more than 70 parts by weight, based on the dry composition.
- 15 24. A composition according to claim 23, wherein the cement replacement composition is ground granulated blast furnace slag and/or pulverised fuel ash.
25. A composition according to any one of claims 20 to 24, wherein the cement is calcium silicate cement
- 20 26. A composition any one of claims 20 to 25, further comprising aggregate and/or fibre reinforcement.
27. A composition according any one of claims 20 to 26, further comprising not more than 50 parts by weight water, based on the wet composition.
- 25 28. A cementitious mortar composition comprising a mixture of cementitious composition according to any one of claims 20 to 27 and with sand.
- 30 29. A pipe comprising a hollow metallic conduit and a coating provided on an internal and/or external surface of the conduit, wherein the coating comprises a composition according to any one of claims 20 to 28.

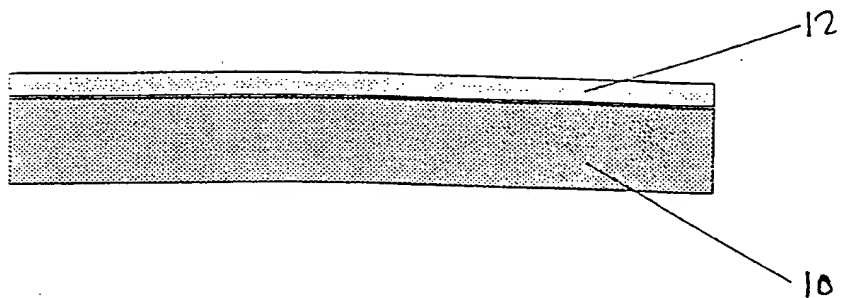


FIG. 1

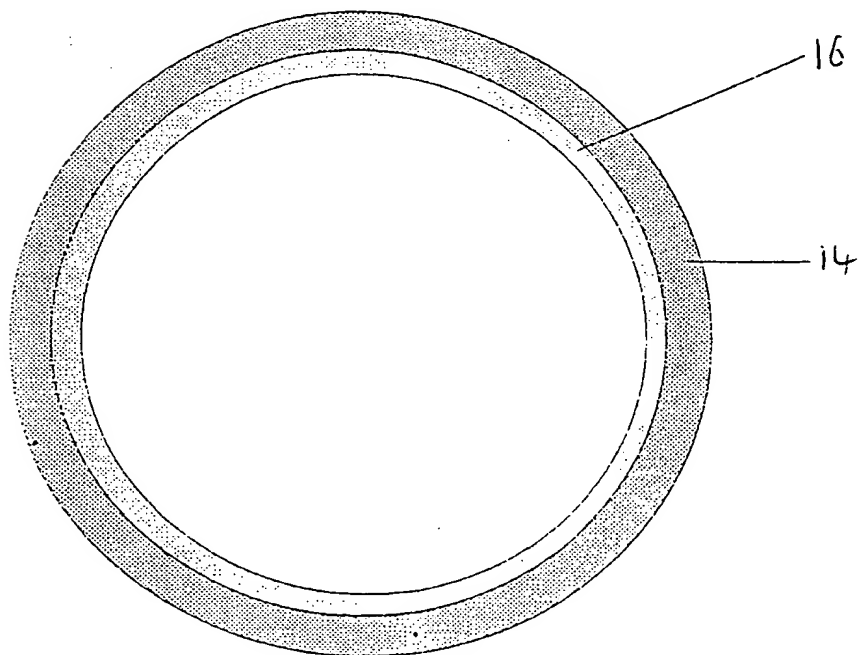
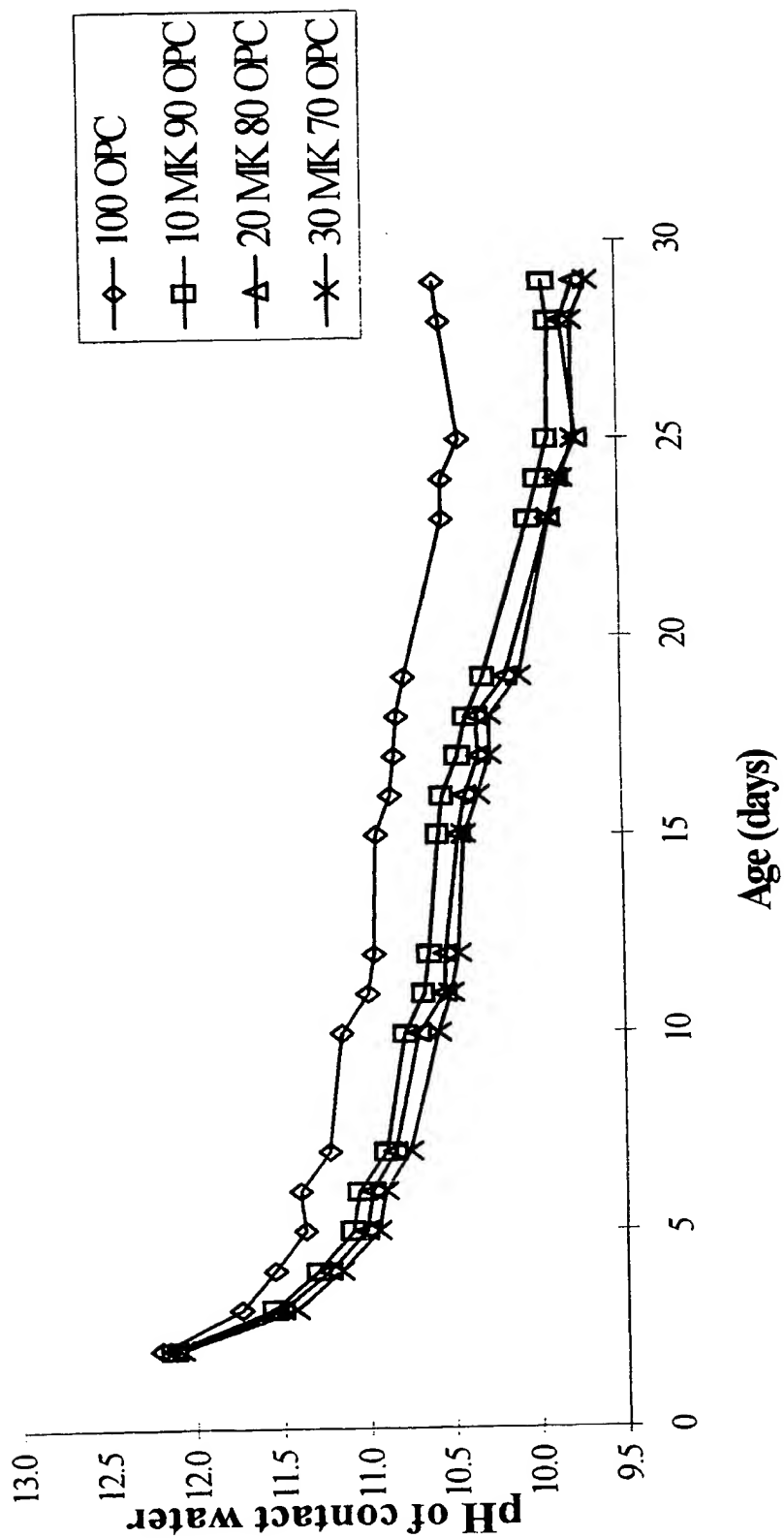


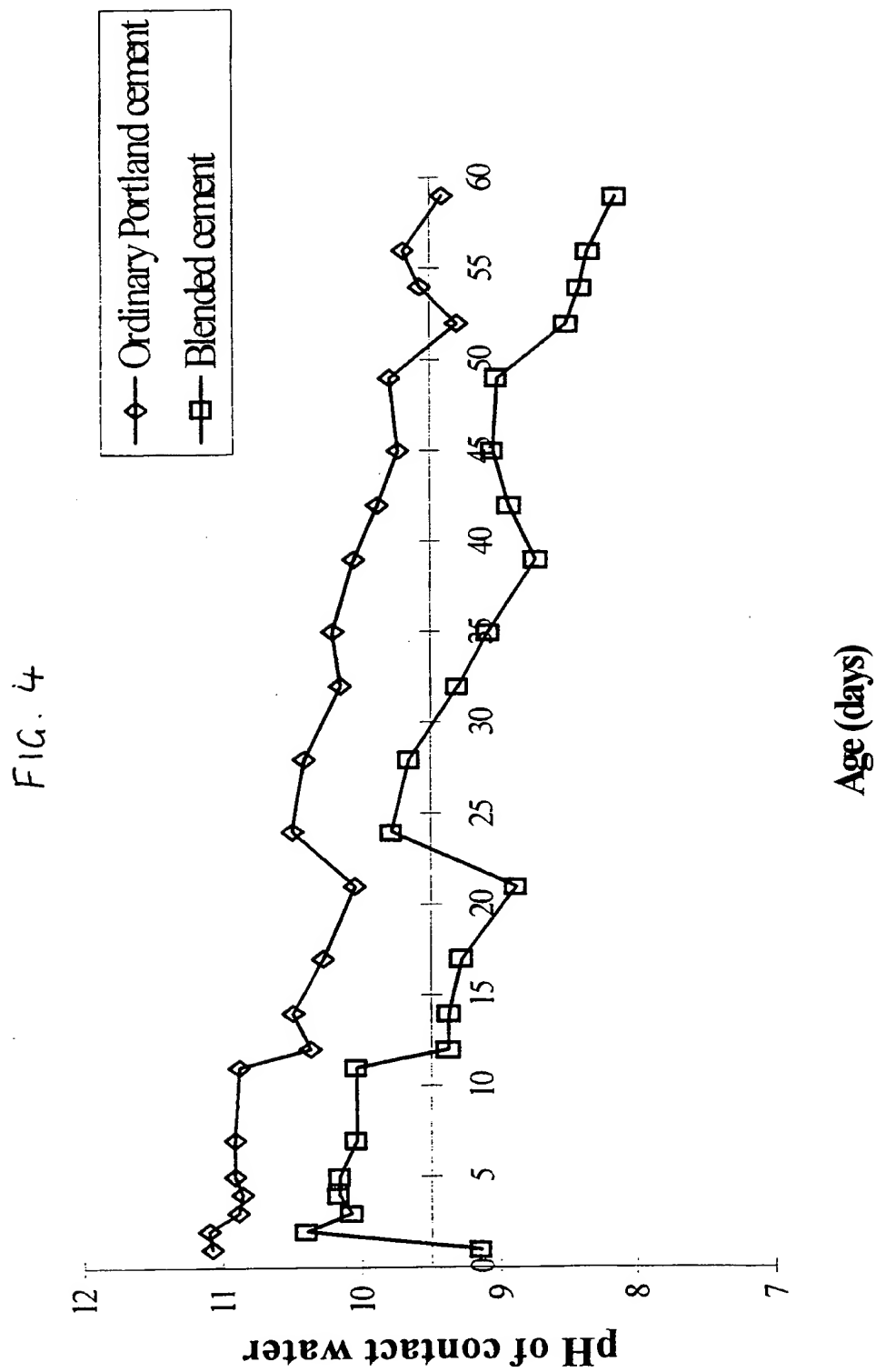
FIG. 2

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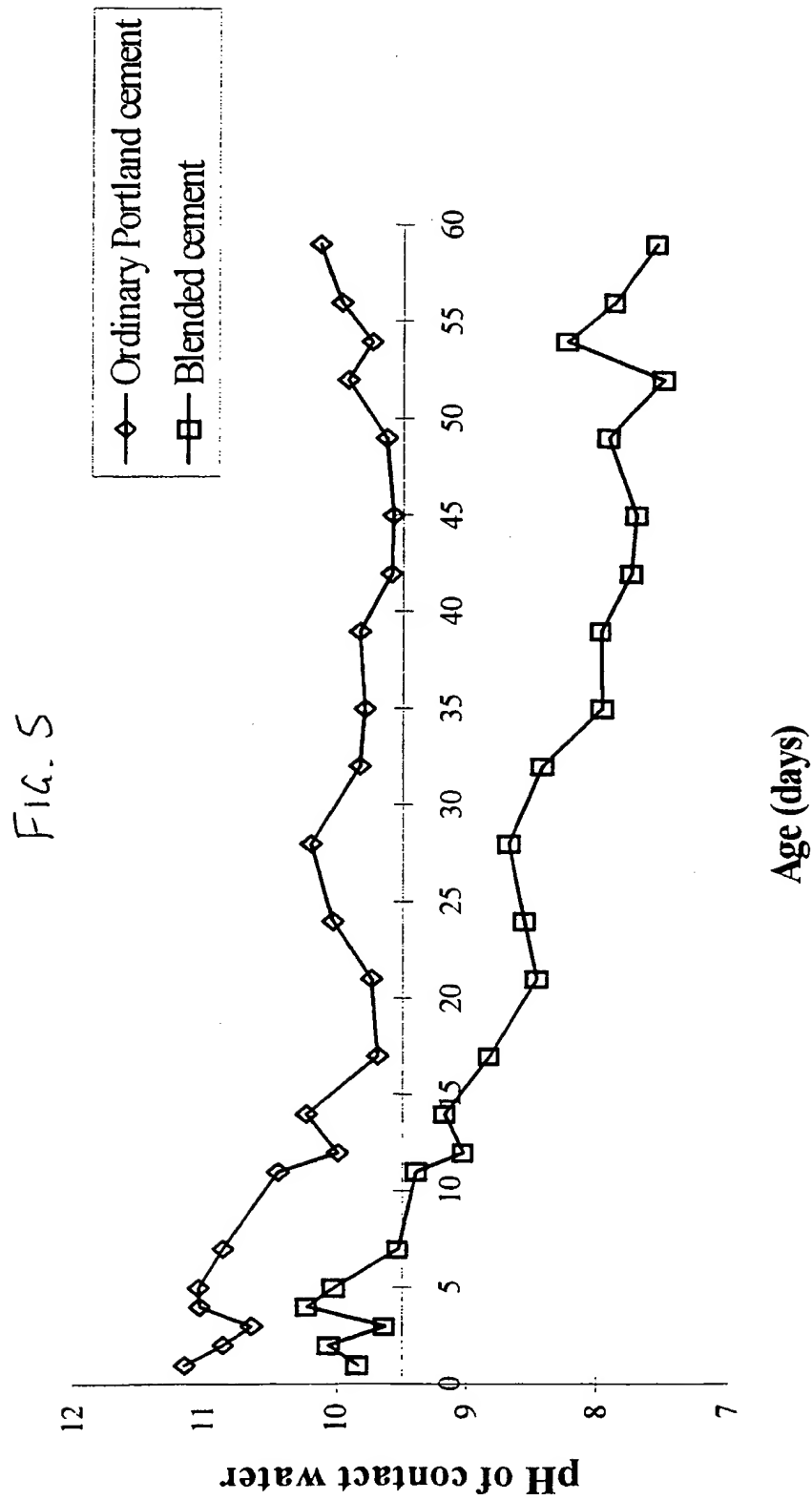
FIG. 3



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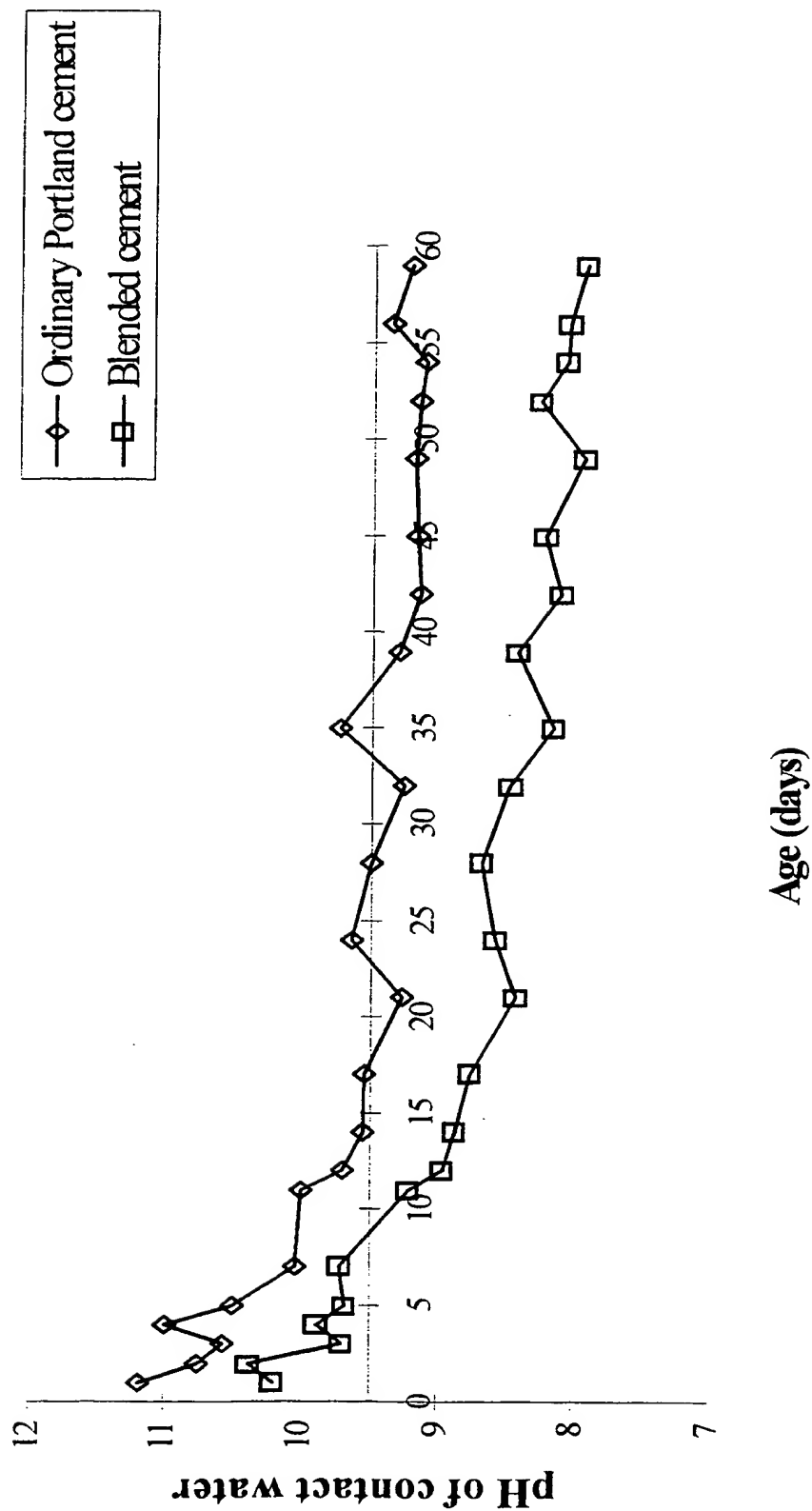
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Fig. 6



# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/GB 98/00305

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 C04B28/02 C04B41/65 F16L58/06 //(C04B28/02,14:10),  
C04B111:56

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 C04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 294 259 A (ECC INT LTD) 24 April 1996 see page 1, paragraph 4 - page 2, paragraph 2; claims	1-4,20
X,P	DE 196 00 445 A (WESTER MINERALIEN GMBH) 10 July 1997 see the whole document	20-22, 26-28
Y		1-3,10, 12-14, 17-19
Y	WO 95 11863 A (UNION OIL COMPANY OF CALIFORNIA) 4 May 1995	1-3,10, 12-14, 17-19
A	see claims 1,11	29
	-/--	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

\* Special categories of cited documents :

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Date of the actual completion of the international search

27 April 1998

Date of mailing of the international search report

07/05/1998

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Theodoridou, E

## INTERNATIONAL SEARCH REPORT

International Application No  
PCT/GB 98/00305

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 89 02878 A (LONE STAR IND INC) 6 April 1989 see claims; examples	20-24, 27,28
A	CHEMICAL ABSTRACTS, vol. 115, no. 24, 16 December 1991 Columbus, Ohio, US; abstract no. 262057n, XP000285704 see abstract & JP 03 164 459 A (DENKI KAGAKU KOGYO K.K.) 16 July 1991	1,2,10, 12,14, 15,17-19

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 98/00305

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
GB 2294259	A	24-04-1996	NONE		
DE 19600445	A	10-07-1997	NONE		
WO 9511863	A	04-05-1995	AU	7643794 A	22-05-1995
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			ZA	8800581 A	28-07-1988

## PATENT COOPERATION TREATY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

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<b>Date of mailing (day/month/year)</b> 25 September 1998 (25.09.98)	
<b>International application No.</b> PCT/GB98/00305	<b>Applicant's or agent's file reference</b> PAC/18541
<b>International filing date (day/month/year)</b> 02 February 1998 (02.02.98)	<b>Priority date (day/month/year)</b> 01 February 1997 (01.02.97)
<b>Applicant</b> CONROY, Paul, James et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

01 September 1998 (01.09.98)

☐ in a notice effecting later election filed with the International Bureau on:2. The election ☒ was☐ was not

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# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>PAC/18541</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/GB 98/ 00305</b>	International filing date (day/month/year) <b>02/02/1998</b>	(Earliest) Priority Date (day/month/year) <b>01/02/1997</b>
Applicant  <b>WRC PLC et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. ☐ Certain claims were found unsearchable (see Box I).

2. ☐ Unity of invention is lacking (see Box II).

3. ☐ The international application contains disclosure of a **nucleotide and/or amino acid sequence listing** and the international search was carried out on the basis of the sequence listing

☐ filed with the international application.

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4. With regard to the **title**, ☒ the text is approved as submitted by the applicant

☐ the text has been established by this Authority to read as follows:

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☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is:

Figure No. 2 ☒ as suggested by the applicant.

☐ None of the figures.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 98/00305

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 C04B28/02 C04B41/65 F16L58/06 //(C04B28/02,14:10),  
C04B111:56

According to International Patent Classification(IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 C04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 294 259 A (ECC INT LTD) 24 April 1996 see page 1, paragraph 4 - page 2, paragraph 2; claims	1-4,20
X,P	DE 196 00 445 A (WESTER MINERALIEN GMBH) 10 July 1997 see the whole document	20-22, 26-28
Y		1-3,10, 12-14, 17-19
Y	WO 95 11863 A (UNION OIL COMPANY OF CALIFORNIA) 4 May 1995	1-3,10, 12-14, 17-19
A	see claims 1,11	29
	-/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

27 April 1998

Date of mailing of the international search report

07/05/1998

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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 98/00305

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 89 02878 A (LONE STAR IND INC) 6 April 1989 see claims; examples ---	20-24, 27,28
A	CHEMICAL ABSTRACTS, vol. 115, no. 24, 16 December 1991 Columbus, Ohio, US; abstract no. 262057n, XP000285704 see abstract & JP 03 164 459 A (DENKI KAGAKU KOGYO K.K.) 16 July 1991 -----	1,2,10, 12,14, 15,17-19



## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 98/00305

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
GB 2294259	A	24-04-1996	NONE	
DE 19600445	A	10-07-1997	NONE	
WO 9511863	A	04-05-1995	AU 7643794 A US 5649568 A	22-05-1995 22-07-1997
WO 8902878	A	06-04-1989	US 4842649 A AU 598912 B AU 1223188 A CA 1327373 A DE 3873324 A DK 268689 A EP 0346350 A FI 892558 A GR 1000400 B IE 62188 B JP 2501381 T MX 166306 B PT 87333 B ZA 8800581 A	27-06-1989 05-07-1990 18-04-1989 01-03-1994 03-09-1992 01-06-1989 20-12-1989 25-05-1989 30-06-1992 28-12-1994 17-05-1990 29-12-1992 30-10-1992 28-07-1988

C04B 28/18



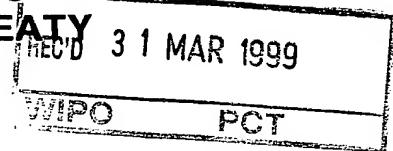
XP 000285704

p379

115: 262057n Lining of water pipes with mortar. Sasagawa, Yukio; Sato, Masataka (Denki Kagaku Kogyo K. K.) Jpn. Kokai Tokkyo Koho JP 03,164,459 [91,164,459] (Cl. C04B28/04), 16 Jul 1991, Appl. 89/302,231, 22 Nov 1989; 6 pp. Water pipes from steel or cast iron are lined by mixing a binder contg. a CaO-contg. material and a SiO<sub>2</sub>-contg. material with sand and water, centrifugally molding in the pipes, and autoclaving. Thus, portland cement 61.3, fused SiO<sub>2</sub> 38.7, and sand 200 wt. parts were kneaded with water, centrifugally molded in a cast iron pipe, and autoclave cured to give a lined pipe.

# PATENT COOPERATION TREATY

## PCT



### INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference <b>PAC/18541</b>	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. <b>PCT/GB98/00305</b>	International filing date (day/month/year) <b>02/02/1998</b>	Priority date (day/month/year) <b>01/02/1997</b>
International Patent Classification (IPC) or national classification and IPC <b>C04B28/02</b>		
Applicant <b>WRc PLC et al.</b>		

- This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 6 sheets, including this cover sheet.
  - ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand <b>01/09/1998</b>	Date of completion of this report <b>29.03.99</b>
Name and mailing address of the international preliminary examining authority:  <b>European Patent Office D-80298 Munich Tel. (+49-89) 2399-0 Tx: 523656 epmu d Fax: (+49-89) 2399-4465</b>	Authorized officer <b>Hoyer, W</b> Telephone No. (+49-89) 2399 8439 

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB98/00305

**I. Basis of the report**

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

**Description, pages:**

1-7 as originally filed

**Claims, No.:**

1-29 as originally filed

**Drawings, sheets:**

1/5-5/5 as originally filed

**2. The amendments have resulted in the cancellation of:**

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

**4. Additional observations, if necessary:**

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB98/00305

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

### 1. Statement

Novelty (N)	Yes:	Claims	7,9,29
	No:	Claims	1-4,6,8,10-28
Inventive step (IS)	Yes:	Claims	29
	No:	Claims	1-28
Industrial applicability (IA)	Yes:	Claims	1-29
	No:	Claims	

### 2. Citations and explanations

**see separate sheet**

## VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**Re Item V**

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. The following documents (D) are referred to in this communication; the numbering will be adhered to in the rest of the procedure:

D1 = GB-A-2 294 259

D2 = WO-A-89/02878

D3 = WO-A-95/11863

- 1.1 D1 discloses a pozzolanic material for incorporation in a concrete composition in order to enhance its durability in low pH environments (cf. p. 1 of D1). The pozzolanic composition comprises mixture of 2 - 50 wt.% metakaolin in an aqueous medium. At p. 3, first paragraph it is mentioned that metakaolin enhances the durability of glass fibre-reinforced concrete.

The disclosure in D1 is novelty-destroying for claims 1 - 4, 6, 13 - 15, 20 and 26, at least in their present, unclear form (cf. item VIII below).

- 1.2 D2 discloses a cement composition comprising 50 - 80 parts portland cement, up to 10 parts metakaolin, 13 - 35 parts fly ash and up to 6 parts slag (cf. the claims of D2). Portland cement contains calcium silicates. The slag is particularly blast furnace slag (cf. p. 4, 3rd paragraph of D2). According to Example 2 of D2, the composition may further comprise "aggregate" in form of gravel and sand. the water content based in the wet composition is less than 50 parts by weight.

The disclosure in D2 is novelty-destroying for claims 20 - 28.

- 1.3 D3 discloses the provision of a lining for metal pipes in order to enhance their corrosion resistance especially for geothermal fluids. In particular, a mixture comprising cement, preferably portland cement is used. The cement includes fibrous material and non-fibrous aggregate, such as silica flour which is considered as a type of "sand". The dry mixture is hydrated so as to form a slurry. It appears that such requires less than 50 parts by weight of water, based on the

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EXAMINATION REPORT - SEPARATE SHEET**

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wet composition (see in this connection, Example 2 of D2). For reference, see pages 1 to 3 of D3.

The disclosure in D3 is novelty-destroying for claims 1, 2, 8 and 10 - 19 at least in their present, unclear form (cf. item VIII below).

2. According to the comments above, claims 1 - 4, 6, 8 and 10 - 28 do not meet the requirements of Art. 33(2) PCT. The subject-matter of claims 7 and 9 rather appears to refer to design-features of their known antecedents. Such is not considered as inventive. Thus those claims do not meet the requirements of Art. 33(3) PCT. The subject-matter of claim 29 is not known or implied by the available prior art. Thus, the requirements of Art. 33 PCT are met for this claim.

**Re Item VI**

**Certain documents cited**

Application No Patent No	Publication date (day/month/year)	Filing date (day/month/year)	Priority date (valid claim) (day/month/year)
DE-A-196 00 445	10.07.1997	09.01.1996	--

The validity of the priority claim of the present application has not been checked because the priority documents were not available.

**Re Item VIII**

**Certain observations on the international application**

1. Obscurity arises as to the scope of protection sought when reading claims 1 and 2 which are defined by result ("... composition which ... acts as low leaching coating in low alkalinity and low hardness waters"; "... component which is capable of reacting with free lime"). A claim must contain all essential features which enable the skilled person to carry out the invention (cf. the PCT-Guidelines ch. III, 4.4). If a claim is defined by result it has to be considered that the skilled person is familiar with the particular method to achieve the result. In such a case, however, it is not derivable which features of claims 1 and 2 should be considered as novel and inventive. This objection is compounded since definitions, such as

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"cementitious composition", "low leaching coating", "low alkalinity" "low hardness water" have not a clearly limited meaning. The feature "... component which is capable of reacting with free lime" is already anticipated by water. In the broadest possible interpretation, claim 1 appears to be already anticipated by any application of a paint for the protection of any surface in contact with rain water which is normally of low alkalinity and hardness. In this connection, the wording "cementitious composition" without further definition is considered to be covered by any hardening composition, for instance a polymer which is a usual component of paints (e.g. polyacrylate or epoxy resin) and which does not leach in the hardened state if contacted with water.

2. Furthermore, obscurity arises as to claims 5 to 7 and 22 which are broader defined than their antecedents. Claims 5 to 7 and 22, which refer inter alia back to claims 4 or 21, respectively, claim "pozzolan" which has a broader meaning than "metakaolin" claimed in the antecedents.
3. Claims 8 and 23 are not clear as the feature "cement replacement material" has an indefinite meaning.
4. Consequently, claims 1, 2, 5 - 8, 22 and 23 do not meet the requirements of Art. 6 PCT.